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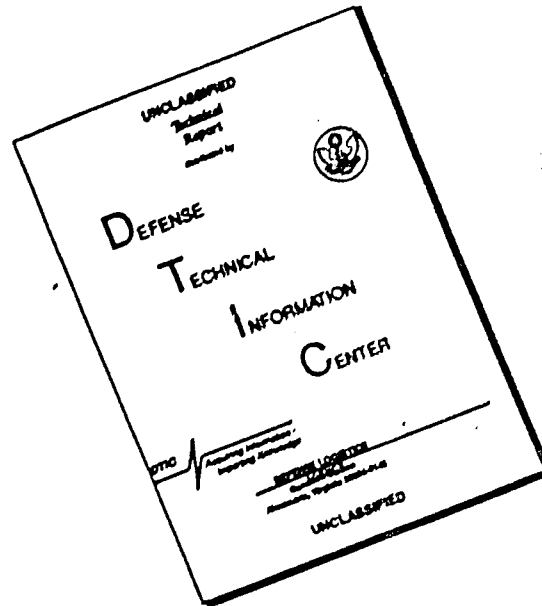
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⑭ AMRL-TR-65-199

⑥ **ZOOMETRIC MEASUREMENTS AND ORGAN WEIGHTS
OF THE BLACK BEAR .**

⑨ *Final rept. Jun 65,*

⑩ NEVILLE P. CLARKE, ~~MAJOR, VC, USAF~~
and
STEPHEN J. DOELKER .

⑪ *Dec 65,*

⑫ *5p*

⑬ AF-7231

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FOREWORD

This report was prepared by Major Neville P. Clarke, USAF, VC, Chief, Vibration and Impact Branch, Biodynamics and Bionics Division of the Biophysics Laboratory, Aerospace Medical Research Laboratories, with the assistance of Mr. Stephen J. Doelker, University of Dayton, Dayton, Ohio. The data reduction was accomplished under Project 7231, "Biodynamics of Aerospace Operations," Task 723101, "Effects of Vibration and Impact." The data for this report were taken from clinical and postmortem records of experimental animals used in the development program for the B-58 escape capsule. The tables were compiled in June 1965.

This technical report has been reviewed and is approved.

J. W. HEIM, PhD
Technical Director
Biophysics Laboratory
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ABSTRACT

Zoometric measurements and organ weights of 13 black bears used as experimental animals in the B-58 escape capsule development program are reported. These data are intended for use in future experiments where external dimensions of the test animal are required and for useful information in determining the comparability of the black bear to man in terms of biodynamics characteristics.

SECTION I

INTRODUCTION

The black bear has become one of the experimental animals used in biodynamics research as a "comparative analog" of man (refs. 5, 7). In this use, there are recognized similarities and dissimilarities. One of the more extensive experimental uses made of the bear was as the experimental animal in the live tests which supported the development and evaluation of the B-58 escape capsule (ref. 2). In this program, 13 adolescent animals, 12 American and 1 Himalayan black bears were used in impact tests, high-speed sled ejection tests, and ejections from a specially modified B-58 aircraft. Responses to the resulting acceleration environment were evaluated both clinically and by postmortem examination.

During the course of these experiments, the lack of zoometric data on the bear was recognized as a problem in terms of design of special support and restraint systems for the animal and in establishing spatial geometry of the hardware immediately surrounding the subject comparable to that proposed for man.

Evaluation of the bear, as an experimental animal, in terms of the comparability of his biodynamic characteristics to those of man, is a continuing effort (ref. 4). For instance, in present programs, measurement of the whole body impedance and tissue strength and Young's modulus of bear organs are being made. One of the problems in making the comparison between bear and man is that there do not yet exist sufficient numbers of measurements of organ weights of the bear.

Even though the measurements and, in some cases, the postmortem examinations of the animals used in the B-58 experiments were made under field conditions and are not sophisticated or complete, the data collected in this program are presented herein to provide some additional information on the physical characteristics of the black bear.

SECTION II

METHODS

ZOOMETRIC MEASUREMENTS:

Measurements were made with the animals under general anesthesia as a part of the pretest procedure. The animals were fasted 12 hours prior to administration of anesthetic. Measurements were made with a flexible metal tape measure. The results are compared in Table I to the 50th percentile man (ref. 6).

ORGAN WEIGHTS:

Whole body weights were made at the time of necropsy. The animals were anesthetized with pentobarbital sodium (ref. 3) and sacrificed for postmortem examination by exsanguination. This procedure, which was done to facilitate recognition of minute hemorrhages in the tissues, probably contributed to the difference in organ weights between the bear and human, particularly for tissues such as lung, spleen, and liver (Table II). Organ weights obtained at necropsy are expressed in Table III as the ratio of organ to whole body weight, for both the bear subjects and the reference 50th percentile human (ref. 1).

TABLE I

ZOCOMETRIC MEASUREMENTS OF THE BEAR

Bear No.	Type*	Weight (cm)	Sitting Height (cm)	Crown Shoulder (cm)	Shoulder Height (cm)	Tibial Length (cm)	Femoral Length (cm)	Waist Circum. (cm)	Chest Circum. (cm)	Neck Circum. (cm)	Radial Length (cm)	Humeral Length (cm)	Stature (cm)	Front Limb (cm)	Rear Limb (cm)
HSR41	AM	38,556	81.3	15.2	66.0			63.5	55.9			20.3			
HSRS-11	AM	38,556	81.3	20.3				78.7	73.7				134.6	60.9	53.3
A/C2-12	AM	45,587	101.6	22.9		22.9	27.9		71.1		25.4	36.8			
HSRS-15	AM	54,886	99.1	20.3				86.4	78.7				154.9	53.3	55.9
HSRS-11	AM	56,700	105.4	24.1	85.1	25.4	33.0	63.5	66.0	53.3		27.9	182.9		
HSRS-16	AM	58,968	96.5	22.9				81.3	78.7				157.7	68.6	63.5
A/C2-14	AM	64,411	109.2	25.4	83.8	21.6	33.0	87.6	81.3	52.1	25.1	23.5	176.5		
A/C2-13	HM	65,999	109.2	20.3	88.9	25.4	39.4	83.8	81.3		27.3	29.2	180.3		
A/CS-12	AM	72,576	106.7	12.7				88.9	86.4				152.4	71.1	68.6
A/C2-15	AM	77,112	111.8	25.4	86.4	26.0	36.2	93.9	94.6	58.4	26.0	22.9	195.3		
A/CS-10	AM	83,462	119.4	15.2				116.8	106.7				177.8	73.7	66.0
Average			101.9	20.4	82.0	24.2	33.9	84.4	79.5	54.6	25.9	26.8	168.0	65.5	61.5
50th Percentile Man			91.4	31.9†	59.2	38.4	47.1	80.5	98.2	37.9	25.2	33.6	175.6	69.4‡	83.3

*AM - American Black Bear
HM - Himalayan Black Bear

† Stature 175.6
Shoulder Ht. - 143.7

‡Sleeve Inseam 50.4
Hand Length +19.0
69.4

TABLE II
BEAR ORGAN WEIGHTS

	Bear No. 8 (108 lb) Weight (gm)	Bear No. 3 (110.75 lb) Weight (gm)	Bear No. 11 (100.5 lb) Weight (gm)	Bear No. 12 (135.7 lb) Weight (gm)	Bear No. 13 (134 lb) Weight (gm)	Bear No. 14 (156 lb) Weight (gm)	Bear No. 15 (125 lb) Weight (gm)	Bear Average (124.2 lb) Weight (gm)	50th Percentile Human Weight (170 lb) Weight (gm)
Whole Body	48,989.0	50,236.0	45,587.0	61,553.0	60,782.0	70,761.0	56,700.0	56,373.0	77,112.0
Heart	295.0	302.0	225.0	370.0	385.0	422.0	300.0	328.0	275.0
Lungs	250.0	318.0	325.0	370.0	360.0	340.0	300.0	324.0	825.0
Thymus	-	79.0	19.2	44.0	-	-	-	47.4	21.0
Liver	650.0	965.0	675.0	829.0	795.0	899.0	875.0	812.0	1,650.0
Spleen	100.0	118.0	75.0	120.0	78.0	109.0	72.0	96.0	155.0
Pancreas	38.0	-	57.6	66.0	66.0	-	56.6	26.2	110.0
Right Kidney and Adrenal	54.0	77.0	80.3	105.0	92.0	179.0	102.3	33.3	155.7
Left Kidney and Adrenal	51.0	79.0	68.7	104.0	122.0	181.0	91.3	30.5	155.7
Brain	230.0	220.0	250.0	222.0	260.0	222.0	222.9	51.9	1,337.5

TABLE III

RATIO OF BEAR ORGAN WEIGHT TO BODY WEIGHT

	Bear No. 8 (108 lb) Weight (gm)	Bear No. 9 (110.75 lb) Weight (gm)	Bear No. 11 (100.5 lb) Weight (gm)	Bear No. 12 (135.7 lb) Weight (gm)	Bear No. 13 (134 lb) Weight (gm)	Bear No. 14 (156 lb) Weight (gm)	Bear No. 15 (125 lb) Weight (gm)	Bear Average (124.2 lb) Weight (gm)	50th Percentile Human Weight: (170 lb) Weight (gm)
Whole Body	48,989.0	50,236.0	45,587.0	61,553.0	60,782.0	70,761.0	56,700.0	56,374.0	77,112.0
Heart	0.006	0.006	0.005	0.006	0.006	0.006	0.005	0.006	0.004
Lungs	0.005	0.006	0.007	0.006	0.006	0.005	0.005	0.006	0.011
Thymus	....	0.0015	0.0004	0.0007	....	....	....	0.0008	0.0002
Liver	0.013	0.019	0.015	0.013	0.013	0.013	0.015	0.015	0.021
Spleen	0.002	0.002	0.002	0.002	0.001	0.002	0.001	0.002	0.002
Pancreas	0.001	....	0.001	0.001	0.001	....	0.001	0.001	0.001
Right Kidney and Adrenal	0.001	0.002	0.002	0.002	0.002	0.003	0.002	0.002	0.002
Left Kidney and Adrenal	0.001	0.002	0.002	0.002	0.002	0.003	0.002	0.002	0.002
Brain	0.005	0.004	0.005	0.004	0.004	0.003	0.004	0.004	0.017

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